REMARKS

Applicant responds to each rejection as follows:

The Office Action

The official action of May 20, 2002 rejected claim 17 under 35 U.S.C. § 112, 1st paragraph as lacking enabling disclosure. Claim 18 was rejected under 35 U.S.C. § 112, 2nd paragraph as being indefinite.

Claims17 – 19, 22, 23, 26, 27, 29, and 30 were rejected under 35 U.S.C. § 102(b) as anticipated by Nath et al. (Thin Solid Films, 1980). In making this rejection, Nath, et al. was characterized as teaching an ITO film with an electrical resistivity of $7X10^{-5}$ ohms/cm. The office action further stated that Nath et al. does not disclose activity of Sn in the film or its structure, it is expected that since these characteristics would be inherent to the film since it exhibits the claimed resistivity.

Claims 20, 21, 24 and 25 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Nath et al. In view of Koden et al. (US 5539546). In making this rejection, it was admitted that Nath et al. do not teach deposition in a pattern. However, the Koden et al. patent was relied on for teaching an ITO film formed on a substrate patterned into a striped configuration.

Claims 28 and 31 – 33 were rejected as unpatentable over Nath et al. in view of Kwok et al. (Thin Solid Films, November 1998). Nath et al. was asserted for the teachings described above, and Kwok was asserted to teach ITO films formed on various substrates. Kwok was relied on for teaching deposition in the

range of 420 degrees Celsius. According to the office action, it would have been obvious to optimize the temperature range at which the film is formed, since applicant's claimed temperature range was considered to be a general condition.

The References

All of the prior art rejections rely on Nath et al., either exclusively or in combination with other references.

Nath et al. discloses a resistivity of $7X10^{-5}$ ohms-cm. Nath et al. also disclose the substrate as discussed by the examiner on page 464 of the publication. However, the graph of page 465, showing resistivity, fails to disclose whether the film was deposited on a glass substrate or a quartz substrate. As is well known, glass is not a crystalline substrate. Glass is an amorphous material, not crystalline. Accordingly, there is no teaching as to whether the resistivity measurement levels were obtained with respect to a crystalline substrate. Nath et al. is silent in this regard.

Additionally, Nath et al. fail to disclose, teach or suggest the formation of an ITO film deposited on a quartz or crystalline substrate by epitaxial growth. By the epitaxial growth method, highly oriented films are produced when the film is grown on a crystalline substrate. The diffraction pattern of FIG. 4 (page 467) has a concentric structure. This shows that the film is not highly oriented, and suggests that the film is not epitaxially grown.

Kwok discloses ITO being formed on YSZ at a temperature of 420 degrees Celsius by the PLD method. According to pages 300-301, the best resistivity is $3X10^{-4}$ ohms meter which is substantially the same as the best value of amorphous ITO on glass. According to the PLD method, the conductivity of ITO film has little relevance to crystality, and even if the crystality is increased, conductivity is not increased.

This is opposite to the idea of the present invention in that low resistance is achieved by increasing crystality. That is, Kwok suggested that if the film is manufactured at a temperature of more than 500 degrees Celsius to improve film crystality, further improvement for low resistance cannot be achieved. Accordingly, one of ordinary skill in the art would not be motivated to come up with the idea of the present invention. In fact, this disclosure of Kwok actually teaches away from the present invention. As discussed in the specification, when the film is formed at a temperature of 500 degrees or more, a high degree of crystality influences the mobility and, at the same time, the production efficiency of the carriers is maintained to a high degree.

The office action also characterized the temperature of the substrate as a general condition. This statement is respectfully traversed. As disclosed on page 14, lines 6-6, the temperature is not a general consideration. It is a specific consideration. Accordingly, the disclosed temperature of Kwok is 80-580 degrees less than that specifically disclosed and claimed by applicant. For at least all of the foregoing reasons, a *prima facia* case of obviousness has not

been established. Accordingly, reconsideration and withdrawal of the rejection is respectfully requested.

The additional reference relied on in the office action fail to clarify the Nath et al. publication as to how the resistivity, disclosed by Nath et al. Is achieved. Accordingly, the additional references fail to supplement the teaching of Nath et al. In view of the foregoing, it is submitted that a *prima facia* case of obviousness has been established.

CONCLUSION

Attached hereto are four (4) pages which present a marked up version of the changes made to this application by the current amendment. The first page of the four attached pages is captioned "VERSION WITH MARKINGS TO SHOW CHANGES MADE."

It should be understood that the above remarks are not intended to provide an exhaustive basis for patentability or concede the basis for the rejections in the Office Action, but are simply provided to overcome the rejections made in the outstanding Office Action in the most expedient fashion.

In view of the above amendments and remarks, it is respectfully submitted that the present application is in condition for allowance and an early Notice of Allowance is earnestly solicited. If, after reviewing this amendment, the Examiner feels that any issues remain which must be resolved before the application can be passed to issue, the Examiner is invited to contact the Applicants' undersigned representative by telephone to resolve such issues.

Respectfully submitted,

By ____________________

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS

Please cancel Claims 17 – 33 without prejudice or disclaimer of the subject matter therein.

Please add new Claims 34 – 48 as follows:

-- 34. (New) A low resistance ITO thin film having a resistivity less than $1 \times 10^{-4}\ \Omega$ cm, said film deposited on a crystalline substrate by epitaxial growth.

35. (New) A low resistance ITO thin film according to claim 34, wherein Sn dopant activity defined as {carrier density (cm^{-3})/ Sn density in said ITO film (number of Sn / cm^3)} is greater than 80%.

36. (New) A low resistance ITO thin film according to claim 34, wherein mobility is greater than 39 cm^2/Vs.

37. (New) A substrate having a low resistant ITO thin film comprising:

a crystalline substrate; and

a low resistance ITO thin film having a resistivity lower than $1 \times 10^{-4}\ \Omega$ cm produced for deposition on said crystalline substrate by epitaxial growth.

38. (New) A substrate having a low resistant ITO thin film according to claim 37, wherein Sn dopant activity defined as {carrier density (cm^{-3})/ Sn density in said ITO film (number of Sn / cm^3)} is greater than 80%.

39. (New) A substrate having a low resistant ITO thin film according to claim 37, wherein mobility of said ITO thin film is greater than 39 cm^2/Vs.

40. (New) A substrate having a low resistant ITO thin film according to claim 37, wherein said ITO thin film has a pattern formed thereon.

41. (New) A substrate having a low resistant ITO thin film according to claim 37, wherein said ITO thin film has a In_20_3 crystal structure of one of a C-rare earth type and a corundum type.

42. (New) A substrate having a low resistant ITO thin film according to claim 37, wherein said ITO thin film is formed on said substrate which has a temperature of 500 – 1000 °C by a pulsed laser deposition method.

43. (New) A substrate having a low resistant ITO thin film according to claim 37, wherein said ITO thin film is formed by one of a low-voltage sputtering, an oxygen cluster beam deposition, a chemical vapor deposition, a metal organic chemical vapor deposition, a metal organic chemical vapor deposition, a metal

organic chemical vapor deposition – atomic layer deposition, and a molecule beam epitaxy.

44. (New) A substrate having a low resistant ITO thin film according to claim 37, wherein said crystal substrate is provided to accept an $In_2 0_3$ crystal structure deposited thereon.

45. (New) A substrate having a low resistant ITO thin film according to claim 37, wherein said substrate is a single crystal substrate.

46. (New) A substrate having a low resistant ITO thin film according to claim 37, wherein said crystalline substrate is one of a YSZ single crystal substrate, a substrate on which a C-axis oriented Zn0 thin film is formed, a sapphire substrate, a SiC single crystal substrate and a silicon single crystal substrate.

47. (New) A substrate haaving a low resistant ITO thin film according to claim 37, wherein said crystalline substrate has a C axis oriented Zn0 film formed thereon.

48. (New) The method for manufacturing a low-resistance ITO film of claim 37, said method comprising a step of:

depositing an ITO film on a crystalline substrate having a temperature of 500-1000°C by a pulsed laser vapor deposition method.

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